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ABSTRACT

This paper reports a study of selected examples of verbal behavior patterns in primary grade classrooms during science activities. The subjects were 32 elementary teachers within five mid-Michigan public school districts. A control group of 16 teachers taught science in the conventional manner. The experimental group received an in-depth study of the Science Curriculum Improvement Study's (SCIS) teaching methods and materials at a 3-week workshop, and used the teaching methods and materials suggested by SCIS in their classrooms. The study was designed as a quasi-experimental, time-series analysis and involved a series of science teaching observations over a one-year period. Each science lesson was recorded with portable tape recorders, and two of the three instruments used in evaluating the data were concerned with information gathered from analyses of the taped lessons. The data indicated that the SCIS teachers differed significantly from those teachers employing conventional science teaching methods and materials by demonstrating an increase in the amount of direct teacher influence displayed in verbal behavior patterns during science activities. Additionally, the SCIS teachers displayed a preference toward asking high-level questions of children. Bibliography. (LC)

A Study of Verbal Behavior Patterns in Primary Grade Classrooms During Science Activities

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Introduction

In the past decade an increased interest in American elementary school science curricula has become evident. A wide spectrum of curriculum innovations has blossomed onto the educational scene that profess to focus upon the elementary school child and how he learns science. And rightly so, for he represents the recipient of that wealth of scientific knowledge deemed important for him as a functioning member of his society. These new science materials also stress the importance of elementary school teachers and how their teaching roles are modified through the introduction of such programs. In practice the actions of the individual teacher determine the curriculum within any respective classroom. The basis for this study stems from a consideration of such teacher actions in response to the introduction of a recent curriculum innovation, the Science Curriculum Improvement Study.

The problem in this study was to analyze selected examples of verbal behavior patterns in primary grade classrooms during science activities. This analysis included verbal behavior

patterns of classrooms using conventional science curriculum materials as well as classrooms using the Science Curriculum Improvement Study. Student-to-student verbal patterns as well as teacher verbal patterns were analyzed in this study.

Mallinson stated that two areas exist in elementary school science that are in dire need of educational research. She wrote that research is needed to identify those things that science should help children do better, and that researchers must concentrate upon determining how any given curricular method may be used more effectively.[1] Both of these examples are heavily dependent upon teachers' effectiveness in communicating the goals of instruction to the children under their guidance.

The spoken discourse within the classroom has been studied profitably from many standpoints and for many purposes. Hough stated that a visit to a typical elementary or secondary school will reveal that 60 per cent of classroom time is taken up in verbal interaction and that more than 70 per cent of such talk is done by teachers.[2] Hughes further attested to the importance of effective verbal communication when she stated that a measure of good teaching is the quality of the response the teacher makes to the child or group with whom he is interacting.[3]

One set of exemplars that are representative of such verbal interactions within the elementary school classroom focuses upon the effective use of questions. Jacobson and Kondo have written that questions can be used by the teacher to stimulate thinking, to initiate discussion, to appraise what children have learned, and to determine what they are talking about.[4] Snyder

also emphasized the importance of questions as a measure of verbal interaction when he stated that measuring question-asking behavior may serve as a means of evaluating new science curricula and as a means of determining the effects on inquiry of different science teaching methodologies.[5]

The Science Curriculum Improoevment Study heavily emphasizes child-to-child communication as an integral aspect of science lessons. An effective teacher is one who is aware of this emphasis and structures the learning activity in such a way that this communication is enhanced.

Definitions

The following are definitions, statements, or assumptions as they were used in this study.

According to Bellack, verbal interaction means the communication of language and meaning in the classroom, which in turn tends to indicate the behavior of those involved in the classroom.[6] Interaction analysis could be defined as the systematic quantification of behavioral acts or qualities of behavior acts as they occur in some sort of spontaneous interaction.[7] It is an observation procedure designed to permit a systematic record of spontaneous acts and to scrutinize the process of instruction by taking into account each small bit of interaction.

The ID ratio has been defined by Amidon and Flanders as the amount of indirect teacher influence in verbal classroom behavior divided by the amount of direct teacher influence.[8]

In conducting this study it was assumed that: the verbal

behavior of the teacher was an adequate sample of her total behavior; that is, her verbal statements were consistent with her nonverbal gestures; how much teachers talk and what they say determine to a large extent the reactions of the students; the kinds of questions teachers ask are an indication of the quality of teaching that is going on and the levels of thinking that are being stimulated; and the lessons observed and recorded were exemplars of the types of science lessons normally presented by those teachers within the study.

Procedure

This study focused upon an analysis of verbal behavior patterns during science activities in thirty-two mid-Michigan primary grade classrooms. Sixteen of the teachers within these classrooms used the teaching methods and materials suggested by the Science Curriculum Improvement Study (SCIS), and the remaining sixteen teachers presented more conventional science activities as advocated by their respective school systems. These teachers were employed within the DeWitt, East Lansing, Grand Ledge, Laingsburg, and Williamston public schools and taught in nine separate buildings scattered throughout these districts. A three-week workshop (August 5-August 23, 1968) employing the Science Curriculum Improvement Study's teaching methods and materials was the primary experimental variable, and those sixteen teachers who taught science using the SCIS approach during the 1968-69 school year were active participants within the workshop.

Portable tape recorders were used to gather data during each science lesson observed for the thirty-two teachers. Formal observations of the sixteen SCIS teachers began prior to the summer workshop on April 22, 1968, and both the SCIS teachers and those teachers using more conventional science activities received periodic visitations throughout the 1968-69 school year. Specifically, each SCIS teacher received five such visitations; the final lesson was recorded on March 27, 1969.

Three instruments were used in evaluating the study's data. Two of these measurements were exclusively concerned with information gathered from analyses of the taped lessons--the Flanders System of Interaction Analysis[9] and the Science Teaching Observational Instrument.[10] The third instrument, the Science Process Test for Elementary School Teachers, was a written test designed to evaluate process skills and science concepts.[11]

Two individuals were trained to analyze the taped lessons; each lesson, therefore, was reviewed twice-- once to gather data using the Flanders System of Interaction Analysis and a second time using the Science Teaching Observational Instrument. The third evaluation instrument was given to only the experimental group--those teachers who attended the summer workshop and who employed SCIS teaching methods and materials in their classrooms during the 1968-69 school year. A pre-test using this instrument was given to the teachers on August 6, 1968, prior to the summer workshop's formal activities. On April 19, 1969 these teachers were tested again with the same instrument and under similar conditions, at the study's conclusion.

Of the null hypotheses stated in the section that follows, the Flanders System of Interaction Analysis was used in obtaining data to test hypotheses one through four. The Science Teaching Observational Instrument evaluated data gathered for hypothesis five. Hypothesis six was analyzed using the results of pre-test and post-test administrations of the Science Process Test for Elementary School Teachers.

Hypotheses

Stated in null form, the study's hypotheses were:

H_{01} There is no difference in the teachers' ID ratios during science activities, before and after the introduction of SCIS teaching methods and materials ($H_{01}: ID_1 = ID_2$);

H_{02} There is no difference in the percentage of time teachers spend talking during science activities, before and after the introduction of SCIS teaching methods and materials ($H_{02}: TT_1 = TT_2$);

H_{03} There is no difference in the percentage of time students talk during science activities, before and after the introduction of SCIS teaching methods and materials ($H_{03}: ST_1 = ST_2$);

H_{04} There is no difference in the percentage of continuous student comment during science activities, before and after the introduction of SCIS teaching methods and materials ($H_{04}: CC_1 = CC_2$);

H_{05} There is no difference in the kinds of questions teachers ask children, before and after the introduction of SCIS teaching methods and materials ($H_{05}: KQ_1 = KQ_2$);

H_{06} There is no difference in the teachers' comprehension of the process aspects of science, before and after the introduction of SCIS teaching methods and materials ($H_{06}: PS_1 = PS_2$).

Analyses of Results

Initially, analyses were conducted to determine whether there were any significant differences between the SCIS teachers and those teachers using conventional science materials for hypotheses one through four. To obtain necessary statistical data, four separate t-tests were computed on the initial observations of both the sixteen SCIS teachers and the sixteen teachers using more conventional approaches to elementary school science. The results demonstrated that there were no significant differences between these two groups of teachers on the initial observations, in regards to ID ratios, percentage of teacher talk, percentage of student talk, and percentage of continuous student comment during science activities.

Additionally, the investigator determined whether any significant differences had occurred, for hypotheses one through four, between the initial observations and the final observations of those teachers employing conventional science activities. Therefore four separate t-tests for correlated data were calculated between the initial and final observations for this group. The results demonstrated that there were no significant differences between these two observations in regards to ID ratios, percentage of teacher talk, percentage of student talk, and percentage of continuous student comment during science activities.

In regards to the experimental group, a repeated measures design of a mixed model analysis of variance, with an alpha level at .05, was used to evaluate data gathered for hypotheses one

[illegible] of [illegible] generated an F statistic that reached the assigned level of significance. Therefore the null hypothesis [illegible] difference in the teachers' [illegible] the use of [illegible] before and after the introduction of [illegible] and [illegible] H_{07} [illegible] rejected. Table [illegible] supplies descriptive data for this significant analysis of variance.

TABLE 3

ANALYSIS OF VARIANCE FOR THE [illegible]

Source of Variation	SS	df	MS	F
Between Subjects	29.[illegible]	3[illegible]		
Within Subjects				
Treatments	0.2566	4	[illegible]	[illegible]
Error	[illegible].9479	60		
Total	40.4450	79		

$$F_{.95,(4,60)} = [illegible]$$

$$F_{.99,(4,60)} = 3.6$$

Hypotheses H_{02}, $H_{0[illegible]}$, [illegible] concerning percentage of teacher talk, percentage of student talk, and percentage of continuous student comment, during a fence activity within the classroom, failed to produce F statistics that reached the assigned level of significance. Therefore these null hypotheses failed to be rejected.

The Science Teaching Observational Instrument effectively divides teacher questions into five distinct categories and was used to determine whether or not there was a difference in the

kinds of questions teachers ask children, before and after the introduction of SCIS teaching methods and materials (H_{05}: $KQ_1 = KQ_2$).

The Friedman two-way analysis of variance by ranks was used to analyze hypothesis H_{05}.[12] After the percentage of questions asked in each of the five categories per teacher observation was determined, these percentages were ranked across all five observations for the sixteen SCIS teachers. The Friedman statistic was calculated to analyze whether there was a difference in the kinds of questions teachers asked of children during science activities. This statistic was significant ($X_r^2 = 57.7 > 9.48$ at the .05 level of significance). After this original Friedman test produced statistically significant results, additional tests for time by type interactions were performed by making orthogonal tests within the subtables.[13] Table two displays these test results.

TABLE 2

SUMMARY OF TIME BY TYPE INTERACTIONS USING THE FRIEDMAN ANALYSIS OF VARIANCE BY RANKS

Time by Type Interaction	Friedman Statistic (X_r^2)
$T_1 - T_2$	22.11*a
$T_1 + T_2 - 2T_3$	23.61*a
$T_1 + T_2 + T_3 - 3T_4$	10.94*a
$T_1 + T_2 + T_3 + T_4 - 4T_5$	4.35 NS

$^aX^2_{.95, 4df} = 9.49$

Based upon these statistical results concerning teacher preferences for question types, the null hypothesis H_{05} is rejected.

Many of the newer elementary science programs developed within the past decade place emphasis upon teacher comprehension of the basic process skills that good science teaching should foster within children. From such an emphasis, the investigator wished to determine whether or not there would be a difference in the teachers' comprehension of the process aspects of science, before and after the introduction of SCIS teaching methods and materials (H_{06}: $PS_1 = PS_2$). A pre-test using the Science Process Test for Elementary School Teachers was administered to all sixteen SCIS teachers prior to the summer workshop's formal activities. A post-test using this same instrument was given to these sixteen teachers at the study's conclusion. Using a t-test for correlated data, the test scores were analyzed. Table three summarizes the results.

TABLE 3

PRE-TEST AND POST-TEST DATA CONCERNING THE SCIS TEACHERS ON THE SCIENCE PROCESS TEST

	Pre-test	Post-test	T-test
Number of Teachers	16	16	
Mean Score	20.94	20.00	1.29NS
Standard Deviation	5.40	4.98	

$t_{.95,\ 15\ df} = 2.131$

Based upon the statistical results outlined abpve, the null hypothesis H_{06} fails to be rejected.

Throughout the course of the study, random samples of taped lessons analyzed previously were selected and recoded by both individuals trained for lesson analysis as an indication of intra-observer reliability. Flanders advocates the use of Scott's coefficient of reliability for such estimations.[14] This procedure was followed in determining checks using both the Flanders System of Interaction Analysis and the Science Teaching Observational Instrument. Of the sixteen reliability checks recoded, all but two produced results ranging between .70 and .91.

Discussion

Although the data displayed in Table one clearly demonstrates a significant F statistic concerning teacher ID ratios, figure one below more vividly illustrates the implications of this analysis.

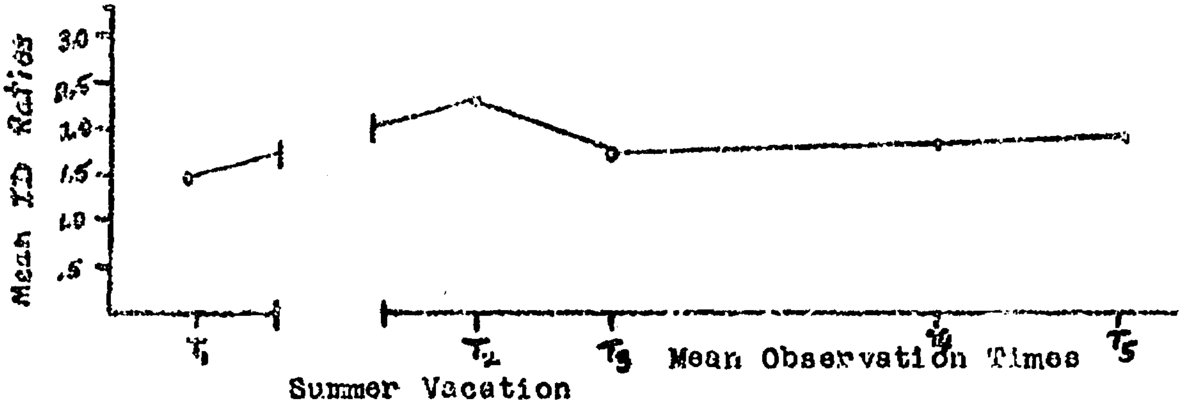

Figure 1

SCIS TEACHERS' MEAN ID RATIOS PER MEAN OBSERVATIONS, N = 16

This graph demonstrates a very high ID ratio at the time two interval (T_2), yet across the remaining observation times there has been a significant decrease. It would appear that the sixteen SCIS teachers attempted a more indirect approach to verbal behavior patterns during the fall months immediately after the workshop's conclusion, then assumed a more direct stance as the school year progressed. Perhaps one explanation for this phenomenon centers upon the fact that the SCIS science program is heavily materials-centered, for the children are actively involved in manipulating such objects as wood samples, pieces of lead, wire, and rubber balloons. The summer workshop greatly emphasized the importance of carefully giving directions to young children before allowing them to handle objects. Most SCIS teachers increased their percentages of direction giving (Flanders category six) across observation times. Such an increase within this category has the effect of depressing the teachers' ID ratios across these same observation times. Fischler and Anastasiow's data trends concerning ID ratios confirm the results mentioned here.[15]

Certainly one set of data that deserves further comment centers upon the sixteen SCIS teachers' preferences for question types across the various observation times. The Science Teaching Observational Instrument contains five categories of questions. Two of these question types, "recall facts" and "see relationships", are of a low order classification and elicit little cognitive skill from the children to effectively answer. The other three question types (make observation, hypothesize, and test hypothesis)

are of a higher order and demand more effort to answer correctly.

There was a pronounced decrease in the teachers' simple recall questions over time and a slight decrease in their preference for questions that focus upon children describing relationships. Likewise, these teachers portrayed noticeable increases in higher level questions that ask children to use data from their observations and to hypothesize. There was very little difference displayed in the teachers' use of questions that demanded hypotheses to be tested, possibly because this question category demands too much sophistication for primary grade children to answer effectively. Additionally, it was noted that while there was a definite shift in question preferences between the SCIS teachers' initial and final observations, no such pronounced shift occurred between the conventional science teachers' question preferences on initial and final observations.

Conclusions

The following conclusions described below seem justified, based upon this study's findings.

1. Those teachers who were exposed to the teaching methods and materials suggested by the Science Curriculum Improvement Study differed significantly from those teachers employing conventional science teaching methods and materials, by demonstrating an increase in the amount of direct teacher influence displayed in verbal behavior patterns during science activities. Apparently this was due to an increased percentage of teacher direction-giving to young children who were actively involved with science materials;

2. There was a pronounced shift in the question preferences displayed by the experimental teachers after the introduction of SCIS teaching methods and materials. The original observations demonstrated a heavy reliance upon low order question types, demanding little cognitive skill from the children to effectively answer. After

the workshop's conclusion, the teachers demonstrated a greater preference for high level questions, which included asking the children to make observations of some on-going sense activity or to reason out (or guess) an answer which is not given as an immediate fact.

3. Although the SCIS summer workshop's activities seemed to have a pronounced influence upon the experimental teachers' science presentations during those fall months immediately following its conclusion, the possibility cannot be discounted that the types of science materials used by these teachers might also have contributed to this influence.

Implications

Based upon the data gathered during observations of science lessons, the implications listed below are worthy of consideration.

1. The Science Curriculum Improvement Study is heavily materials-centered, for the children are actively involved in manipulating various science equipment during science lessons. Because of such a diverse array of activities occurring simultaneously, it was often difficult to differentiate categories eight and nine (student talk-response and student talk-initiation) using the Flanders System of Interaction Analysis. Perhaps a modification of this system will be necessary for future studies involving laboratory-oriented classroom activities.

2. Results from data analysis demonstrated that the SCIS teachers used fewer low order questions and a greater percentage of high order questions immediately after the summer workshop. Yet as the school year progressed, the teachers' preferences for question types began to closely parallel their question patterns demonstrated during those months before participation in the summer workshop. Possibly more effort should be placed upon continual supervision and in-service consultation throughout the school year in future implementation projects, in an effort to sustain any gains made during a summer workshop experience.

3. Some SCIS teachers seemed to expend an unreasonable amount of class time in the distribution and retrieval of science materials. It appears that such elementary school teachers could benefit from systematic instruction in the handling and distribution of science equipment.

Summary

An investigation was conducted to study selected examples of verbal behavior patterns in primary grade classrooms during science activities. Thirty-two elementary teachers within five mid-Michigan public school districts comprised the population under consideration. Sixteen of these teachers taught science in the conventional manner suggested by their respective school districts. Each of the sixteen remaining teaching participants within the experimental population received an in-depth study of the Science Curriculum Improvement Study's teaching methods and materials, for they attended a three week workshop in these techniques during the summer of 1968. This study was designed as a quasi-experimental, time-series analysis and involved a series of science teaching observations that began in April, 1968 and were concluded in March, 1969.

Each science lesson was recorded with easily portable, battery powered tape recorders, and two of the three instruments used in evaluating the study's data were exclusively concerned with information gathered from analyses of the taped lessons.

The data indicated that the SCIS teachers differed significantly from those teachers employing conventional science teaching methods and materials by demonstrating an increase in the amount of direct teacher influence displayed in verbal behavior patterns during science activities. Additionally, the experimental teachers displayed a pronounced preference toward asking high level questions of children, after the introduction of SCIS teaching methods and materials.

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References

1. Jacqueline Buck Mallinson, "What Research in Science Education Is Needed to Strengthen the Elementary-School Science Program?" Science Education, 40 (December, 1956), p.369.

2. John B. Hough, "Ideas for the Development of Programs Relating to Interaction Analysis", Innovative Ideas in Search of Schools: Title III, PACE (Lansing: State Board of Education, 1966), p.98.

3. James Raths, John R. Pancella, and James S. Van Ness, Studying Teaching (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967), p. 21.

4. Willard J. Jacobson and Allan Kondo, SCIS Elementary Science Sourcebook (Berkeley: University of California Regents, 1968), p. 44.

5. William Ray Snyder, "The Question-Asking Behavior of Gifted Junior High School Science Students and their Teachers," Dissertation Abstracts, 27, No.11 (1967), 3738-A.

6. John R. Verduin, Jr., Conceptual Models in Teacher Education (Washington, D.C.: American Association of Colleges for Teacher Education, 1967), p.44.

7. John R. Verduin, Jr., Conceptual Models in Teacher Education (Washington, D.C.: American Association of Colleges for Teacher Education, 1967), p.32.

8. Edmund J. Amidon and Ned A. Flanders, The Role of the Teacher in the Classroom (Minneapolis: Amidon Associates, Inc., 1963), p.29.

9. Edmund J. Amidon and Ned A. Flanders, The Role of the Teacher in the Classroom (Minneapolis: Amidon Associates, Inc., 1963), p.26.

10. Abraham S. Fischler and N.J. Anastasiow, "In-Service Education in Science (A Pilot)", Journal of Research in Science Teaching, 3 (1965), 283-284.

11. Unpublished test written by Evan A. Sweetser, Michigan State University.

12. Sidney Siegel, Nonparametric Statistics, (Chicago: McGraw-Hill Book Company, Inc., 1956), pp. 166-173.

13. James V. Bradley, Distribution-Free Statistical Tests (Wright-Patterson Air Force Base, Ohio: Wadd Technical Report 60-661, 1960), pp.292-296.

14. Edmund J. Amidon and Ned A. Flanders, The Role of the Teacher in the Classroom (Minneapolis: Amidon Associates, Inc., 1963), p.26.

15. Abraham S. Fischler and N.J. Anastasiow, "In-Service Education in Science (A Pilot)," Journal of Research in Science Teaching, 3 (1965), 280-285.